

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing: 08 February 2001 (08.02.01)	
International application No.: PCT/US00/19785	Applicant's or agent's file reference: 769/VB
International filing date: 20 July 2000 (20.07.00)	Priority date: 30 July 1999 (30.07.99)
Applicant: SHERMAN, Faiz, Feisal et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International preliminary Examining Authority on:
30 August 2000 (30.08.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer:</p> <p>J. Zahra</p> <p>Telephone No.: (41-22) 338.83.38</p>
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WIPO

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 7691/VB	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/19785	International filing date (day/month/year) 20/07/2000	Priority date (day/month/year) 30/07/1999
International Patent Classification (IPC) or national classification and IPC F15C5/00		
Applicant THE PROCTER & GAMBLE COMPANY et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 30/08/2000	Date of completion of this report 05.11.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Lemble, Y Telephone No. +49 89 2399 8914 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US00/19785

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-19 as originally filed

Claims, No.:

1-29 with telefax of 12/10/2001

Drawings, sheets:

1/12-12/12 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US00/19785

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
☐ paid additional fees.
☐ paid additional fees under protest.
☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
☒ not complied with for the following reasons:
see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☐ all parts.
☒ the parts relating to claims Nos. 1-26.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims 1-26
 No: Claims

Inventive step (IS) Yes: Claims 1-26
 No: Claims

**INTERNATIONAL PRELIMINARY
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International application No. PCT/US00/19785

Industrial applicability (IA) Yes: Claims 1-26
 No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Item IV

Lack of unity (Rule 13 PCT).

The application lacks unity within the meaning of Rule 13 PCT for the following reasons.

The separate inventions or group of inventions claimed in the application are the following:

1. A microvalve for controlling fluid flow, a method of electrostatically actuating a microvalve between a first position and a second position, and a fluid-breathing voltaic battery comprising a fluid exchange system including a microvalve having a first and a second positions, as claimed respectively in independent claims 1, 22 and 26 with their respective dependent claims 2 to 21 and 23 to 25. The special technical features which link these independent claims appear to lie in the provision of a latching mechanism for retaining said microvalve in one of said first and second position;
2. A method of fabricating an electrostatic microvalve and an electrostatic microvalve, as claimed in respectively in independent claims 27 and 28 with dependent claim 29. The special features which link these independent claims appear to lie in the specific structure of the microvalve resulting from the method of fabricating that valve, namely the provision of first and second wafers, wherein a top surface of the first wafer is etched to create a shutter and a plurality of actuators operative with said shutter, and of a sacrificial layer having a portion removed so as to release said actuators.

The subject-matter of each of said group of claims relates to features which are not linked so as to form a single general inventive concept within the meaning of Rule 13.1. More particularly, no common novel concept linking together the independent claims of each of said group of claims could be recognized. When comparing the inventions defined in each of said group of independent claims no **common special technical feature** in the sense of Rule 13.2 PCT is to be found, which is not already known from the prior art cited in the international preliminary search report (see Point V below).

Item V

Independent claims 1, 22 and 26.

These claims relate respectively to:

- a microvalve for controlling fluid flow, especially in fluid breathing batteries (metal-air cell);
- a method of actuating a microvalve; and
- a fluid-breathing voltaic battery comprising a fluid exchange system including a microvalve.

The object of the invention is to minimize parasitic current drain on the battery.

This object is achieved by combining an electrostatic drive mechanism for causing a shutter of the microvalve to move and a latching mechanism for preventing said shutter from moving when it is not activated.

This combination, common to all three independent claims is not suggested by the cited prior art documents.

The electrostatic valve according to the invention can utilize the charge of the cell to drive the valve so that the parasitic drain is much less than for thermal or magnetic valves. The use of an electrostatic drive for actuating a shutter of a microvalve is known from US-A-5 400 824 (D3). There is, however, no suggestion to provide that valve with a latch. WO-A-99/16096 (D2) discloses a "thermally driven" actuator combined with a "thermally driven" latch. US-A-5 837 394 (D1) utilizes a resistive element to drive the shutter of a microvalve and a passive latching mechanism.

The subject-matter of these claims is also industrially applicable.

Therefore the subject-matter of the respective claims 1, 22 or 26 appears to meet the requirements of Articles 33 (2) and 33 (3) PCT.

Dependent claims 2 to 21, 23 to 25.

These claims relate to developments of the inventive concept disclosed in the

independent claim 1, 22 or 26 to which they are respectively appended.

Item VII

The technical features mentioned in the claims are not followed by reference signs relating to these features, contrary to Rule 6.2(b) of the PCT.

In contradiction with the requirements of Rule 6.3 (b) (i) and (ii) PCT, the independent claims have not been cast in the two part form, with those features which in combination are part of the prior art (see documents D1, D2 or D3) being placed in the preamble.

The documents D1, D2 and D3 have not been identified in the description nor has the relevant background art disclosed therein been discussed. The requirements of Rule 5.1(a)(ii) PCT are, thus, not fulfilled.

The description has not been adapted to the new claims

Item VIII

In independent claim 22 the expression "controlling fluid flow moving **perpendicular to said microvalve**" is not clear, since the microvalve does not no define any preferred extension or direction to which fluid flow could be perpendicular. For the purpose of this report, the expression has been interpreted as meaning that the microvalve controls fluid flow moving **perpendicular to the shutter**".

The vague and imprecise statement in the description on page 20, last paragraph implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity of the claims (Article 6 PCT) when used to interpret them. This statement should therefore be amended to remove this inconsistency.

What is claimed is:

1. A microvalve for controlling fluid flow, comprising:
 - (a) a body portion having a plurality of spaced openings formed therein;
 - (b) a shutter located adjacent to and substantially parallel with said body portion, said shutter having a plurality of spaced openings formed therein;
 - (c) a drive mechanism for causing said shutter to move with respect to said body portion so that said spaced openings of said shutter are brought into and out of alignment with said spaced openings of said body portion, wherein said microvalve is in an open position and a closed position, respectively; and
 - (d) a latching mechanism for preventing said shutter from moving with respect to said body portion.
2. The microvalve of claim 1, wherein said shutter is biased in said closed position.
3. The microvalve of claim 2, said latching mechanism being utilized to prevent said shutter from moving when in said open position.
4. The microvalve of claim 1, wherein said shutter is biased in said open position.
5. The microvalve of 4, said latching mechanism being utilized to prevent said shutter from moving when in said closed position.
6. The microvalve of claim 1, said shutter further comprising:
 - (a) a substantially rectangular frame having a first pair of sides substantially parallel to said spaced openings and a second pair of sides substantially perpendicular to said spaced openings; and
 - (b) a plurality of spaced finger-like members extending between said second pair of frame sides defining said spaced openings therebetween.

7. The microvalve of claim 6, said latching mechanism further comprising:
 - (a) an ear extending from at least one of said second pair of frame sides; and
 - (b) an electrostatic comb drive positioned adjacent each of said second pair of frame sides having said ear, wherein said electrostatic comb drive is movable so as to engage and disengage said ear and thereby prevent and permit said shutter from moving, respectively.
8. The microvalve of claim 6, said latching mechanism further comprising at least one electrostatic comb drive positioned adjacent at least one of said second pair of frame sides, wherein said electrostatic comb drive is movable so as to engage and disengage said shutter frame and thereby prevent and permit said shutter from moving, respectively.
9. The microvalve of claim 8, wherein said shutter forms a spine for said electrostatic comb drive.
10. The microvalve of claim 6, wherein said drive mechanism is an electrostatic comb drive attached to each of said first pair of frame sides.
11. The microvalve of claim 1, said shutter further comprising:
 - (a) a substantially circular frame having a center portion; and
 - (b) a plurality of spaced members extending between said center portion and said frame defining said spaced openings therebetween.
12. The microvalve of claim 11, said latching mechanism further comprising:
 - (a) an ear extending from said frame; and
 - (b) an electrostatic comb drive positioned adjacent said frame proximate said ear, wherein said electrostatic comb drive is movable so as to engage and disengage said ear and thereby prevent and permit said shutter from moving, respectively.

13. The microvalve of claim 11, said latching mechanism further comprising at least one electrostatic comb drive positioned adjacent said frame, wherein said electrostatic comb drive is movable so as to engage and disengage said shutter frame and thereby prevent and permit said shutter from moving, respectively.
14. The microvalve of claim 11, wherein said drive mechanism is an electrostatic comb drive attached to said frame.
15. The microvalve of claim 1, wherein power to disengage said latching mechanism is maintained only during a change in position of said shutter.
16. The microvalve of claim 1, wherein power to said drive mechanism is maintained only while said latching mechanism is disengaged.
17. The microvalve of claim 1, wherein a predetermined amount of fluid is able to leak through said microvalve in the closed position.
18. The microvalve of claim 1, wherein said shutter is movable to a position intermediate said open and closed positions so as to permit a partial opening of said microvalve.
19. The microvalve of claim 1, wherein said drive mechanism causes said shutter to move linearly with respect to said body portion and said latching mechanism prevents said shutter from moving with respect to said body portion.
20. The microvalve of claim 1, wherein said drive mechanism causes said shutter to move non-linearly with respect to said body portion and said latching mechanism prevents said shutter from moving with respect to said body portion.

21. The microvalve of claim 1, further comprising a controller for providing power to said drive mechanism and said latching mechanism.
22. A method of electrostatically actuating a microvalve between a first position and a second position, said microvalve including a shutter located adjacent a body portion, comprising the following steps:
- (a) disengaging a latching mechanism so as to permit movement of said shutter with respect to said body portion;
 - (b) actuating a drive mechanism to move said shutter from said first position to said second position with respect to said body portion; and
 - (c) engaging said latching mechanism so as to prevent movement of said shutter from said second position.
23. The method of claim 22, said disengaging step occurring immediately prior to and during movement of said shutter.
24. The method of claim 22, said actuating step occurring only while said latching mechanism is disengaged.
25. The method of claim 22, further comprising the step of biasing said shutter in said first position.
26. A fluid-breathing voltaic battery, comprising:
- (a) a container;
 - (b) a voltaic cell disposed within said container; and
 - (c) a fluid exchange system comprising:
 - (1) a microvalve having a first state and a second state, said microvalve being disposed in said container such that said microvalve is located between a fluid flow and said cell, wherein said microvalve is adapted to allow a fluid into said cell

when said microvalve is in said first state and to substantially prevent said fluid from flowing into said cell when said microvalve is in said second state;

- (2) a controller electrically connected to said microvalve, said controller being adapted to initiate a change of state in said microvalve; and
- (3) a latching mechanism for retaining said microvalve in one of said first and second states.

27. A method of fabricating an electrostatic microvalve, comprising the following steps:

- (a) providing a first wafer having a top surface and a bottom surface;
- (b) providing a masking material on said top surface of said first wafer;
- (c) providing a second wafer having a top surface and a bottom surface;
- (d) etching a plurality of spaced openings on said top surface of said second wafer;
- (d) bonding said bottom surface of said first wafer to said top surface of said second wafer via a sacrificial layer;
- (e) etching said masking material of said first wafer to create a shutter and a plurality of actuators operative therewith;
- (f) etching a portion of said second wafer so as to create a passage in flow communication with said spaced openings etched on said top surface thereof; and
- (g) removing a portion of said sacrificial layer between said first and second wafers to release said actuators.

28. An electrostatic microvalve, comprising:

- (a) a first wafer having oxide on a top surface thereof, wherein said top surface is etched to create a shutter, a plurality of actuators operative with said shutter, and a latching mechanism to prevent movement of said shutter;

- (b) a second wafer having a plurality of spaced openings etched on a top surface thereof, wherein a portion of said second wafer in substantial alignment with said spaced openings is etched therefrom so as to create a passage in flow communication therewith; and
- (c) a sacrificial layer positioned between said first and second wafers to bond said first and second wafers, said sacrificial layer having a portion removed in substantial alignment with said flow passage so as to release said actuators.

29. The electrostatic microvalve of claim 28, wherein a thickness for said sacrificial layer is predetermined so as to permit a designated leakage flow through said microvalve when spaced openings in said shutter are not in alignment with said spaced openings in said second wafer.

PATENT COOPERATION TREATY

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 7691/VB	<div style="display: flex; justify-content: space-between;"> <div style="width: 40%;"> FOR FURTHER ACTION </div> <div style="width: 60%; font-size: small;"> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. </div> </div>	
International application No. PCT/US 00/19785	International filing date (day/month/year) 20/07/2000	(Earliest) Priority Date (day/month/year) 30/07/1999
Applicant THE PROCTER & GAMBLE COMPANY		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

The abstract is modified as follows:

line 1: after "microvalve" insert "(10)", and after "portion" "(14)";
line 2: after "openings" insert "(18)", and after "shutter" "(12)";
line 3: after "openings" insert "(16)";
line 4: after "mechanism" insert "(20,22)";
line 7: after "mechanism" insert "(36,38,40,42)".

INTERNATIONAL SEARCH REPORT

International Application No.

JP 00/19785

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F15C5/00 H01M2/12 H02N1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F15C H01M H02N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	W0 99 16096 A (MAHADEVAN) 1 April 1999 (1999-04-01) page 28, line 20 -page 29, line 25 page 35, line 22 -page 36, line 15 page 41, line 4 -page 42, line 12 figures 11,15,20,21 ---	1-29
X	W0 99 37013 A (JERMAN) 22 July 1999 (1999-07-22) page 35, line 19 - line 31; figures 31,34 --- -/--	1-10, 15-17, 19,21-29

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

14 November 2000

Date of mailing of the international search report

21/11/2000

Name and mailing address of the ISA

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Authorized officer

SLEIGHTHOLME, G

INTERNATIONAL SEARCH REPORT

International Application No.
P S 00/19785

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5 400 824 A (STOKMAIER) 28 March 1995 (1995-03-28) column 3, line 61 -column 4, line 35 column 6, line 22 - line 34 figures 1,4	27 1,6,10, 12,14, 17,19, 20,28,29
A	US 5 837 394 A (SCHUMM) 17 November 1998 (1998-11-17) cited in the application column 4, line 38 - line 42 column 7, line 66 -column 8, line 12 figure 8	1,26
A	US 5 178 190 A (METTNER) 12 January 1993 (1993-01-12) abstract; figure 1	6,19

INTERNATIONAL SEARCH REPORT

on patent family members

Internat al Application No

P S 00/19785

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9916096	A	01-04-1999	US 5994816 A	30-11-1999
			AU 9212798 A	12-04-1999
			EP 1008161 A	14-06-2000
			US 5955817 A	21-09-1999
			US 6114794 A	05-09-2000
			US 6023121 A	08-02-2000
WO 9937013	A	22-07-1999	AU 2223299 A	02-08-1999
			US 5998906 A	07-12-1999
			US 6134207 A	17-10-2000
			AU 5569599 A	06-03-2000
US 5400824	A	28-03-1995	DE 4101575 A	23-07-1992
			WO 9213200 A	06-08-1992
			DE 59107820 D	20-06-1996
			EP 0521117 A	07-01-1993
US 5837394	A	17-11-1998	US 5541016 A	30-07-1996
			US 5449569 A	12-09-1995
			US 5304431 A	19-04-1994
			WO 9323887 A	25-11-1993
US 5178190	A	12-01-1993	DE 4041579 A	25-06-1992
			JP 4285378 A	09-10-1992